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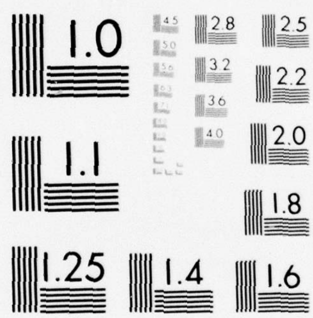
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USAAVSCOM

REPORT - TR 77-8

BENCH TEST EVALUATION OF IMPROVED ELASTOMERIC SEAL FOR OH-58A MAIN DRIVE SHAFT ASSEMBLY, PIP 69-16

J. P. Miller
BELL HELICOPTER COMPANY
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16 June 1972

Final Report

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Maintenance Engineering Division
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This report presents the results of Product Improvement Task 69-16

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Bench Test, Main Input Driveshaft, Chicago Rawhide Manufacturing Company, Environment, Sirvene 406103 Material

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report presents the results of a bench test program conducted to evaluate candidate seals which were proposed replacements for the 206-040-111-7 seal used on the OH58A main input driveshaft, 206-040-100. Four candidate seals were evaluated. Two driveshaft assemblies were run for 150 hours in a dense dust atmosphere while transmitting normal engine power.

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BENCH TEST EVALUATION OF IMPROVED ELASTOMERIC SEAL FOR OH-58A MAIN DRIVESHAFT ASSEMBLY, PIP 69-16

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SUMMARY

This report presents the results of a bench test program conducted to evaluate a candidate seal which was a proposed replacement for the 206-040-111-7 seal used on the OH-58A main input driveshaft, 206-040-100. The purpose of the seal is to provide lubricant retention in the geared couplings and exclude external contamination.

Four candidate seals, part number 720405 manufactured by Chicago Rawhide Manufacturing Company, were installed on two 206-040-100 driveshaft assemblies and tested on the 204-048-017 regenerative driveshaft test stand, BHC R & D Lab. The two driveshaft assemblies were run for 150 hours in a dense dust atmosphere, while transmitting normal engine power.

After 128.5 hours, a trace of coupling lubricant was observed on the external surface of one of the candidate seals. Subsequent investigation revealed a small hole in the seal elastomer. The test was continued to 150 hours with the above candidate seal replaced by the 206-040-111-7 seal (production type).

At the conclusion of 150 hours of bench testing, it was determined that a hole had been generated in one of the three remaining candidate seals, 720405, which had continued to run after previous replacement of the first 720405 candidate seal at 128.5 hours.

Final inspection showed all components of the driveshaft assemblies to be in satisfactory condition despite the occurrence of a hole in two of the candidate seals, one at 128.5 hours and the other at 150 hours. Each candidate seal provided adequate contamination exclusion and no coupling degradation occurred.

Based on the satisfactory condition of the couplings and lubricant after the 150-hour bench test and the accelerated wear environment imposed by the dense dust atmosphere, it was concluded that the candidate seals had performed adequately.

Two additional Chicago Rawhide seals, 720405, were subsequently run during a ground endurance test of an OH58A (not a part of P.I.P. 69-16) for 120 hours with satisfactory results. FAA certification of the 720405 seals was obtained based on the ground endurance test.

INTRODUCTION

This report presents the results of Product Improvement Task 69-16 wherein a bench test evaluation was conducted on a proposed improved elastomeric seal installed on the OH-58A main input driveshaft. The purpose of the new seal was to provide improved resistance to deterioration due to atmospheric elements and to increase the operating temperature range above that of the existing 206-040-111-7 seal.

An evaluation of four candidate materials was made in BHC Transmission Process Laboratory, Reference 1, which consisted of a series of high temperature emersion tests in synthetic oils and coupling greases. The selection of Chicago Rawhide Sirvene 406103 material was made based on superior retention of mechanical properties exhibited during the evaluation. A subsequent bench test of 150 hours duration was made in BHC R & D Laboratory on 204-048-017 driveshaft test stand using four seals manufactured by Chicago Rawhide to part number 720405. The bench test was conducted under extreme environmental dust conditions with the periodic application of SAE J-726A sand into the seal cavity. Oscillatory torque, axial chucking, and oscillatory angular misalignment were also imposed on the driveshafts during the test.

DISCUSSION

TEST STAND DESCRIPTION

The 204-048-017 driveshaft test stand, Figure 1, is a regenerative torque test machine consisting of a drive motor, two parallel gearboxes, two driveshaft assemblies (test section), and a torquing device. The application of torque to the two driveshaft assemblies (Figure 2) is accomplished by generating relative twist of two concentric shafts by the torquing device, which is a rotating helical ramp and follower arrangement. A hydraulic cylinder is used to load the follower against the helical ramps. The gearboxes, one stationary and one movable, provide a 1-1 ratio between the test shafts and are driven by the electric drive motor through the stationary gearbox. The movable gearbox can be articulated to impose axial chucking and oscillatory misalignment to the driveshaft couplings. The test stand is capable of generating 14,000 inch-pounds of torque and 7500 rpm in the test driveshaft assemblies.

TEST PROCEDURE

The bench test of the proposed improved OH-58A driveshaft grease seals was run for a duration of 150 hours under the following conditions:

Speed	6400 RPM
Torque	3100 Steady ± 2000 Osc. In.-Lbs
Driveshaft Misalignment	2 1/4° Steady ± 3/4° Osc.
Axial Motion	.090 Inches Osc.
Oscillatory Frequency	10 CPS

The two driveshafts used in the test were assembled according to BHC drawing 206-040-100 with the exception of the two prototype seals, Figure 3, installed on each shaft assembly in place of the 206-040-111-7 seals, Figure 4. Two and one-half grams of test sand (SAE J-726A) were deposited between the elastomer and the cone of each seal assembly at the start of the test and at every 25-hour interval. At one-hour intervals the surface temperatures of the 206-040-108-5 female couplings were measured by touch pyrometer and the driveshafts were visually inspected for signs of grease leakage.

TEST COMPONENT DESCRIPTION

The proposed improved seal consists of an elastomer (Chicago Rawhide Sirvene 406103) impregnated cloth (nomex tricot) bonded to an aluminum ring and supported radially by an aluminum cone, Figure 3. The new seal is physically and functionally interchangeable with the 206-040-111-7 seal presently used on the 206-040-100 driveshaft assembly.

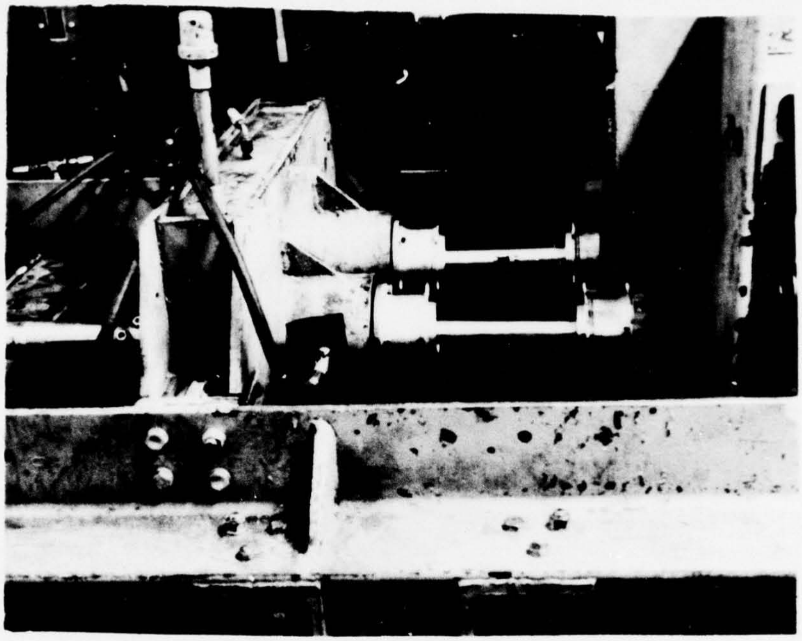

Figure 1. Regenerative Driveshaft Test Stand, 204-048-017.

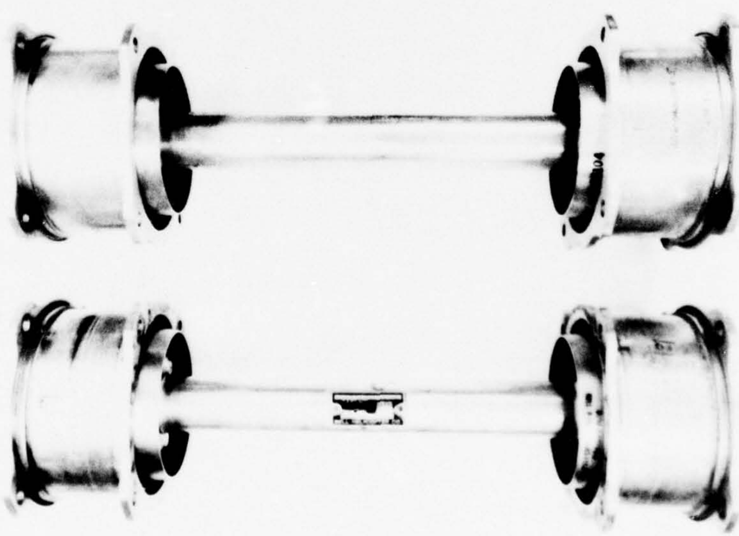

Figure 2. Test Driveshaft Assemblies, 206-040-100.

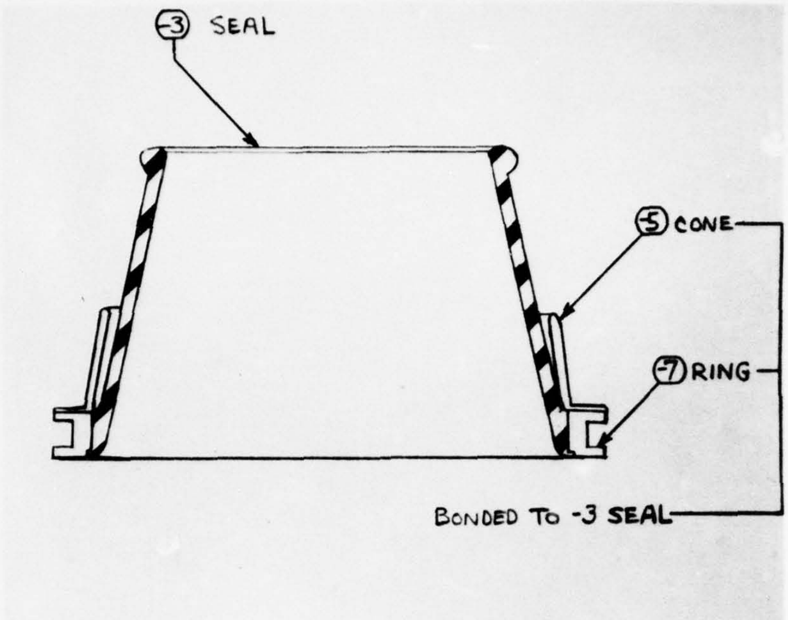

Figure 3. Seal Configuration, Proposed Improved Seal.

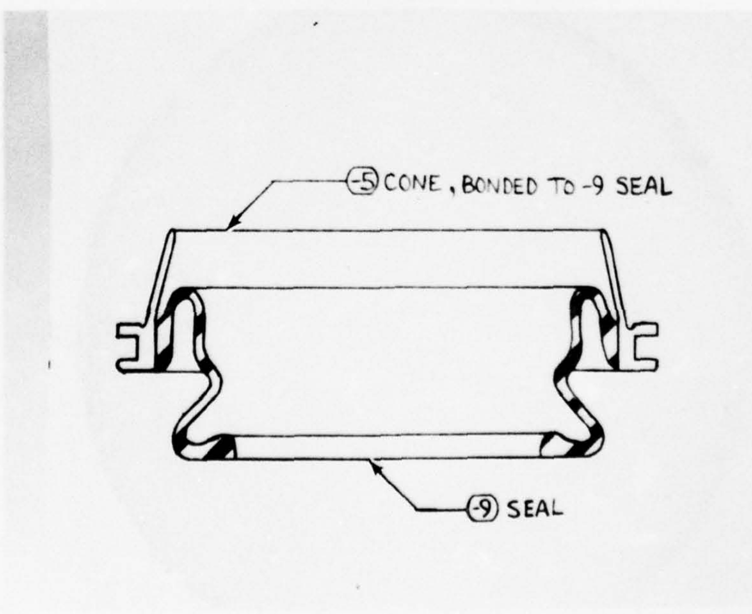

Figure 4. Seal Configuration, 206-040-111-7.

INSTRUMENTATION

Instrumentation used in this test consisted of the following:

1. Recording oscillograph, CEC Model 5-124A (BHC S/N FB2466), to read strain gage output monitoring driveshaft torque.
2. Tachometer-Stroboscope, Model 832 Tachlite, to monitor driveshaft speed.
3. Dial indicators to determine driveshaft misalignment angle.
4. Touch pyrometer, Model 269 Pyrometer Instrument Company (S/N 63-2600) to monitor coupling temperature.

All instruments utilized in this program were calibrated in BHC Standards and Calibration Lab in accordance with manufacturer's requirements.

RESULTS OF TESTING

After 128.5 hours testing, grease was visible on the external surface of the No. 3 test seal, Figure 5. The driveshaft containing this seal was removed from the test stand for partial disassembly and inspection. A small hole was found in the seal elastomer, Figure 6. A standard 206-040-111-7 seal assembly was installed as a replacement for continuation of the test with two and one-half grams of test sand added to the replacement seal only.

Upon completion of the 150-hour test, both driveshaft assemblies were removed from the test stand for disassembly and inspection. A very slight amount of grease was visible on the external surface of the No. 1 test seal and a minute hole was found in the elastomer, Figure 7. Figure 8 shows typical wear on the inner face of the aluminum cone of the seal assembly at the end of the test.

Candidate 720405	Test Time, Hrs.	Discrepancy
1	150	Small hole (Figure 7)
2	150	None
3	128.5	Small hole (Figure 6)
4	150	None

TABLE I - Bench Test History

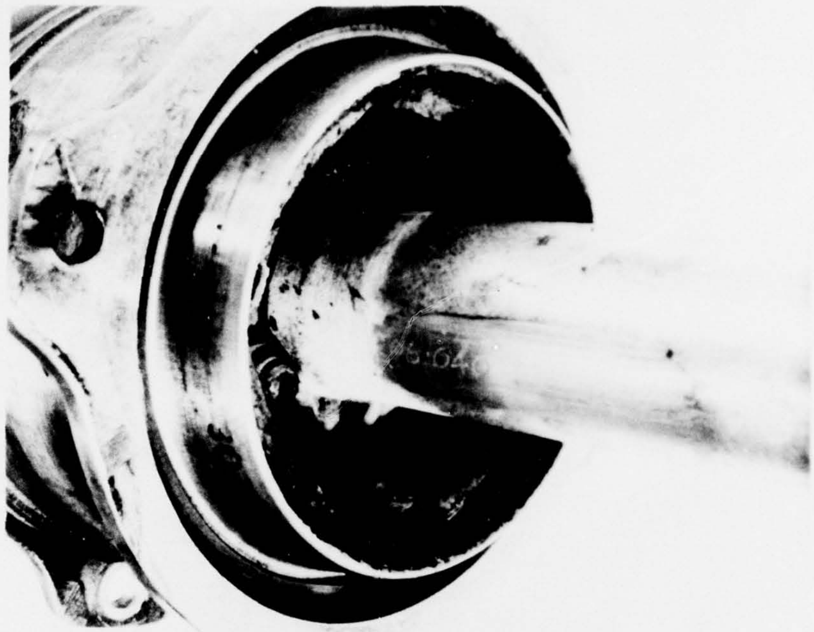

Figure 5. Failed Seal After 128.5 Hours.

Figure 6. Failed Seal After 128.5 Hours, Hole Detail.

Figure 7. Failed Seal After 150 Hours.

Figure 8. Cone Wear After 150 Hours.

CONCLUSIONS

The elastomer-lubricant compatability test (Reference 1) showed improved resistance of the new seal to deterioration in synthetic lubricants and coupling lubricants compared to the 206-040-111-7 seal. The 150-hour bench test showed excellent life in the dense dust atmosphere and the seal provided adequate protection for the geared couplings and coupling lubricant in spite of the development of a hole in each of two of the seals during the bench test.

A ground run of 120 hours duration was made on an OH-58A subsequent to the bench test run with the proposed seals installed on the main driveshaft. Coupling overheating occurred at some time during the ground run at which time the coupling grease deteriorated. However, the improved seal showed no signs of deteriorating (Reference 2) due to the overheating condition and was considered satisfactory for additional operation at the conclusion of the ground run.

RECOMMENDATIONS

Based on the elastomer-lubricant compatability test, the 150-hour bench test and the 120-hour ground run, it is recommended that the improved seal manufactured by Chicago Rawhide Company, P/N 720405 to BHC P/N 206-040-138-1, be accepted as a replacement for the 206-040-111-7 seal.

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1. Maddy, R. D., ELASTOMER-LUBRICANT COMPATABILITY TEST, BHC Report 20671R-003, March 5, 1971.

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TECHNICAL DATA

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PIP Task No. 69-16

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PROJECT ENGR. DATE

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DATE

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* WHEN APPLICABLE

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3. Military Specification MIL-L-7808G, 22 December 1967, LUBRICATING OIL, AIRCRAFT TURBINE ENGINE, SYNTHETIC BASE

4. Federal Test Method Standard No. 601, 12 April 1955, RUBBER: SAMPLING AND TESTING

5. 204-040-755-3 Lubricant, Driveshaft Coupling, UH-1 Series Helicopters, Anderol L-786

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INTRODUCTION

Presented herein are the results of tests to determine the change in the properties of the input driveshaft grease seal elastomer compounds resulting from immersion in synthetic oils and greases. This elastomer-lubrication compatability test was conducted per Reference 1.

The following four temperatures were selected for immersion tests:

1. 250 ±5°F (121.11 ±2.77°C)
2. 225 ±5°F (107.22 ±2.77°C)
3. 200 ±5°F (93.33 ±2.77°C)
4. 175 ±5°F (79.44 ±2.77°C)

The elastomer specimens were immersed in the lubricants to a maximum of 30 days.

Three elastomers in two configurations (Table I) and four lubricants (Table II) were tested at the above temperatures.

RESULTS

The results of the changes in properties of the grease seal elastomers from immersion in the lubricants are given in Tables III through XVIII. The hardness, volume change, and weight change results are an average of two specimens, except where noted. The tensile and elongation results represent one specimen.

SUMMARY

Examination of the test results indicate the following general conclusions:.

1. None of the elastomers tested withstood 30 days in the greases at 250°F.

2. The materials identified as "C" and "F" (Sirvene 406103) showed less change in properties in Anderol L-786 and in Syn-Tech 3913-G than the other elastomers at all temperatures.

3. The MIL-L-7808 and MIL-L-23699 oils caused greater change in properties than did the Anderol L-786 and Syn-Tech 3913-G greases.

4. Material "A" (J8422-13, Type 3) showed less change in properties than material "D" in all the lubricants at all temperatures, although they are the same elastomers.

5. Material "B" (J8422-13, Type 1) showed less change in properties than material "E" in the greases, and more change in the oils, even though they are the same elastomers (reference Table I).

DISCUSSION AND RECOMMENDATIONS

The Chicago Rawhide Sirvene 406103 elastomer showed less overall change in properties in the greases than the Lord J8422-13, Type 1 and 3, elastomers, and is worthy of further testing in test stand operations.

Syn-Tech 3913-G grease shows to be more compatible with the elastomers at the lower temperatures and should be given a more extensive evaluation.

It is recommended that the program be continued to locate improved grease seal elastomers.

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APPARATUS AND TEST METHOD

Sample Preparation

The hardness and volume change specimens from the elastomers identified as "A", "B", and "C" were sectioned in approximately equal portions from the boots. The tensile specimens, which had to be modified due to size, measured 0.25 inch wide by 1.75 inches long by 0.085 inch thick.

Samples for hardness and volume change tests from "D" and "E" materials were prepared to measure approximately 1.0 inch by 2.0 inches by 0.085 inch. The tensile specimens were prepared using an ASTM D-412-51T, Type C, die.

Specimens of "F" elastomer were furnished in the pre-cut condition.

Volume change specimens were also used for weight change tests.

Each sample was tagged for identification.

Immersion Procedure

The specimens were placed in glass beakers. The specified lubricant was added to completely cover the specimen and then heated to the specified test temperatures.

At the end of each test period the samples which were immersed in the oils were removed, placed in fresh oils at room temperature for 30 minutes, then removed, quickly rinsed in acetone, blotted with paper towels and subjected to the respective tests.

The samples in the grease were removed, cooled at room temperature for 30 minutes, quickly rinsed in naptha, blotted with paper towels and subjected to the respective tests.

Test Procedure

Measurements were made before immersion in each test media and immediately after each period of exposure. The periods of exposure at the test temperatures (250, 225, 200 and 175 ±5°F) were 3, 7, 15 and 30 days.

The test specimens used for hardness and weight tests were used for all exposure periods, with each specimen being returned to the respective oven and media following its measurements after each period of exposure. Test measurements were conducted as follows:

Volume - Change in volume was determined in accordance with the procedure under Method 6211 of the Federal Test Method Standard No. 601, Reference 4.

Hardness - Initial hardness and hardness after immersion were measured with a Rex A durometer, in accordance with the procedure described under Method 3021 of the Federal Test Method Standard No. 601, Reference 4.

Tensile Strength and Elongation - Tensile strength and elongation of original specimens and specimens after immersion at 3, 7, 15 and 30 days were determined in accordance with the procedure described under Method 6121 of the Federal Test Method Standard No. 601, Reference 4. Tests were performed using a Scott tensile testing machine.

Weight - Initial weight and change in weight after immersion were determined in accordance with the procedure described under Method 6251 of the Federal Test Method Standard No. 601, Reference 4.

TABLE I

IDENTIFICATION OF ELASTOMERS

Material Designation	Source	Manufacturer's Designation	Composition
A	Lord Mfg. Co.	J8422-13, Type 3 205-040-176-1 Configuration	Urethane
B	Lord Mfg. Co.	J8422-13, Type 1 205-040-176-1 Configuration	Urethane
C	Chicago Rawhide Mfg.	Sirvene 406104 205-040-176-1 Configuration	406103 Elastomer
D	Lord Mfg. Co.	J8422-13, Type 3 Slab Material Configuration	Urethane
E	Lord Mfg. Co.	J8422-13, Type 1 Slab Material Configuration	Urethane
F	Chicago Rawhide Mfg.	Sirvene 406103 Slab Material Configuration	406103 Elastomer

TABLE II

IDENTIFICATION OF LUBRICANTS

Sample Designation	Manufacturer	Manufacturer's Designation	Specification
1	Lehigh Chemical	Anderol L-786	204-040-755-3
2	Syn-Tech Mfg.	Syn-Tech 3913-G	
3	Shell Oil	Aeroshell 500	MIL-L-23699
4	Stauffer Chemical		MIL-L-7808

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TABLE III

ANDEROL-L-786 GREASE @ 250°F

Material	Days	Volume Change %	Hardness Rex A	(PSI) Tensile Strength	Tensile % Change	Elongation %	Elongation Deviation %	Weight Change %
A	Original	-	70	3360	-	275	-	-
	3	4	57	860	74	275	0	3
	7	D	D	875	74	275	9	D
	15	D	D	330	90	100	64	D
	30	D	D	580	83	60	78	D
B	Original	-	75	3810	-	375	-	-
	3	4	55	1790	53	350	7	2
	7	D	D	1100	71	265	29	D
	15	D	D	330	91	140	63	D
	30	D	D	410	89	20	95	D
C	Original	-	65	1700	-	535	-	-
	3	2	65	1610	5	610	14	1
	7	3	57	1140	33	450	16	1
	15	D	D	390	77	250	53	D
	30	D	D	D	D	D	D	D
D	Original	-	75	3690	-	325	-	-
	3	5	65	1000	73	265	18	4
	7	D	D	500	86	350	- 8	D
	15	D	D	D	D	D	D	D
	30	D	D	D	D	D	D	D
E	Original	-	80	4900	-	750	-	-
	3	D	D	D	D	D	D	D
	7	D	D	D	D	D	D	D
	15	D	D	D	D	D	D	D
	30	D	D	D	D	D	D	D
F	Original	NOT SUBJECTED TO 250°F TEMPERATURE DUE TO LIMITED QUANTITY OF SPECIMENS.						
	3							
	7							
	15							
	30							

NOTES: D = Deteriorated

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TABLE IV

ANDEROL L-786 GREASE @ 225°F

Material	Days	Volume Change %	Hardness Rex A	(PSI) Tensile Strength	Tensile % Change	Elongation %	Elongation Deviation %	Weight Change %
A	Original	-	70	3360	-	275	-	-
	3	3	72	2290	32	275	0	2
	7	4	60	3460	- 3	250	9	3
	15	*4	*45	2390	29	100	64	*2
	30	D	D	1870	44	200	27	D
B	Original	-	75	3810	-	375	-	-
	3	2	72	2440	36	350	7	1
	7	3	62	2640	31	245	35	2
	15	4	40	1330	65	190	49	2
	30	D	D	1730	55	250	33	D
C	Original	-	65	1700	-	535	-	-
	3	1	65	1730	- 2	400	25	1
	7	1	65	1210	28	300	44	1
	15	1	65	1310	23	550	- 3	1
	30	1	60	1330	21	450	16	1
D	Original	-	75	3690	-	325	-	-
	3	2	72	2050	44	240	26	1
	7	4	62	1760	52	210	35	3
	15	4	42	1825	50	300	8	2
	30	D	D	1790	51	230	29	D
E	Original	-	80	4900	-	750	-	-
	3	2	75	1140	77	350	53	1
	7	D	D	710	85	290	61	D
	15	D	D	260	95	150	80	D
	30	D	D	595	88	300	40	D
F	Original	-	60	2250	-	800	-	-
	3	1	60	No samples available for this test.				1
	7	1	55	3030	-34	775	1	1
	15	2	55	2250	0	700	12	1
	30	4	50	2200	2	600	25	3

NOTES: D = Deteriorated. *One sample deteriorated.

TABLE V

ANDEROL L-786 GREASE @ 200°F

Material	Days	Volume Change %	Hardness Rex A	(PSI) Tensile Strength	Tensile % Change	Elongation %	Elongation Deviation %	Weight Change %
A	Original	-	70	3360	-	275	-	-
	3	3	70	2680	20	300	- 9	1
	7	4	70	2690	20	270	2	2
	15	5	65	2810	16	320	-16	2
	30	D	D	D	D	D	D	D
B	Original	-	75	3810	-	375	-	-
	3	2	70	3900	- 2	370	1	1
	7	2	70	1640	57	250	33	2
	15	3	62	70	98	50	87	2
	30	D	D	1270	67	140	63	D
C	Original	-	65	1700	-	535	-	-
	3	-1	65	1960	-16	600	-12	0
	7	-2	65	1885	-11	700	-31	0
	15	-2	60	D	D	D	D	0
	30	3	45	D	D	D	D	2
D	Original	-	75	3690	-	325	-	-
	3	3	72	3170	142	260	20	3
	7	5	67	D	D	D	D	4
	15	5	65	D	D	D	D	4
	30	*4	*70	D	D	D	D	*3
E	Original	-	80	4900	-	750	-	-
	3	2	57	900	82	365	51	2
	7	D	D	D	D	D	D	D
	15	D	D	D	D	D	D	D
	30	D	D	240	95	100	87	D
F	Original	-	60	2250	-	800	-	-
	3	1	57	No samples available for this test.				1
	7	2	55	2920	-30	750	6	1
	15	1	55	D	D	D	D	1
	30	9	40	D	D	D	D	6

NOTES: D = Deteriorated. *One sample deteriorated.

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BELL HELICOPTER COMPANY

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TABLE VI

ANDEROL L-786 GREASE @ 175°F

Material	Days	Volume Change %	Hardness Rex A	(PSI) Tensile Strength	Tensile % Change	Elongation %	Elongation Deviation %	Weight Change %
A	Original	-	70	3360	-	275	-	-
	3	2	70	1340	60	275	0	1
	7	3	70	3095	8	300	- 9	2
	15	4	65	2600	22	300	- 9	2
	30	D	D	D	D	D	D	D
B	Original	-	75	3810	-	375	-	-
	3	1	65	1130	70	230	39	1
	7	3	65	3625	5	395	- 5	2
	15	3	60	2560	33	340	9	2
	30	D	D	D	D	D	D	D
C	Original	-	65	1700	-	535	-	-
	3	0	65	1790	- 5	500	7	0
	7	1	65	1790	- 5	395	7	1
	15	0	65	1430	16	450	16	0
	30	*2	*60	D	D	D	D	*1
D	Original	-	75	3690	-	325	-	-
	3	4	75	2325	37	250	23	2
	7	7	65	4150	-12	230	29	5
	15	7	70	3050	17	325	0	5
	30	D	D	2590	30	130	60	D
E	Original	-	80	4900	-	750	-	-
	3	1	80	310	94	100	87	1
	7	3	62	360	93	150	80	2
	15	3	55	2020	59	650	13	2
	30	D	D	D	D	D	D	D
F	Original	-	60	2250	-	800	-	-
	3	0	60	No samples available for this test.				0
	7	1	55	2480	-10	700	12	1
	15	0	55	2840	-26	775	1	0
	30	D	D	1960	13	400	50	D

NOTES: D = Deteriorated. *One sample deteriorated.

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TABLE VII

SYN-TECH 3913-G GREASE @ 250°F

Material	Days	Volume Change %	Hardness Rex A	(PSI) Tensile Strength	Tensile % Change	Elongation %	Elongation Deviation %	Weight Change %
A	Original	-	70	3360	-	275	-	-
	3	7	45	1170	65	450	-64	4
	7	D	D	460	86	270	2	D
	15	D	D	D	D	D	D	D
	30	D	D	D	D	D	D	D
B	Original	-	75	3810	-	375	-	-
	3	7	47	1060	72	440	-17	4
	7	D	D	500	87	290	23	D
	15	D	D	D	D	D	D	D
	30	D	D	D	D	D	D	D
C	Original	-	65	1700	-	535	-	-
	3	6	65	790	53	225	58	3
	7	8	55	800	53	360	33	5
	15	9	55	1210	29	180	66	5
	30	D	D	D	D	D	D	D
D	Original	-	75	3690	-	325	-	-
	3	9	60	1390	62	430	-32	7
	7	D	D	975	74	480	-48	D
	15	D	D	D	D	D	D	D
	30	D	D	D	D	D	D	D
E	Original	-	80	4900	-	750	-	-
	3	7	65	150	97	120	84	5
	7	D	D	240	95	250	67	D
	15	D	D	D	D	D	D	D
	30	D	D	D	D	D	D	D
F	Original	NOT SUBJECTED TO 250°F TEMPERATURE DUE TO LIMITED QUANTITY OF SPECIMENS.						
	3							
	7							
	15							
	30							

NOTES: D = Deteriorated.

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TABLE VIII

SYN-TECH 3913-G GREASE @ 225°F

Material	Days	Volume Change %	Hardness Rex A	(PSI) Tensile Strength	Tensile % Change	Elongation %	Elongation Deviation %	Weight Change %
A	Original	-	70	3360	-	275	-	-
	3	6	67	1460	56	175	36	4
	7	6	57	1885	44	400	-45	4
	15	6	40	1250	63	360	-31	3
	30	D	D	D	D	D	D	D
B	Original	-	75	3810	-	375	-	-
	3	6	70	2360	38	280	25	3
	7	7	50	2680	30	500	-33	4
	15	5	37	1690	56	420	-12	3
	30	D	D	D	D	D	D	D
C	Original	-	65	1700	-	535	-	-
	3	4	65	1140	33	230	57	2
	7	5	60	1140	33	320	40	3
	15	6	60	1080	36	230	57	4
	30	7	60	830	51	330	38	4
D	Original	-	75	3690	-	325	-	-
	3	8	70	2705	27	320	1	6
	7	10	60	2175	41	310	5	7
	15	7	40	1550	58	500	-54	4
	30	D	D	1000	73	300	8	D
E	Original	-	80	4900	-	750	-	-
	3	3	65	470	90	200	73	4
	7	D	D	310	94	180	76	D
	15	D	D	2075	58	650	13	D
	30	D	D	D	D	D	D	D
F	Original	-	60	2250	-	800	-	-
	3	7	57	No samples available for this test.				5
	7	9	55	**2700	-20	800	0	6
	15	10	55	2075	8	650	19	7
	30	14	50	1225	46	300	62	10

NOTES: D = Deteriorated. **Did not break - ran out of travel (20").

7872 55426

BY R. Maddy
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TABLE IX

SYN-TECH 3913-G GREASE @ 200°F

Material	Days	Volume Change %	Hardness Rex A	(PSI) Tensile Strength	Tensile % Change	Elongation %	Elongation Deviation %	Weight Change %
A	Original	-	70	3360	-	275	-	-
	3	6	70	470	86	330	-20	4
	7	8	55	D	D	D	D	5
	15	8	50	D	D	D	D	4
	30	D	D	D	D	D	D	D
B	Original	-	75	3810	-	375	-	-
	3	9	60	810	79	450	-20	5
	7	9	45	400	89	150	60	5
	15	8	45	D	D	D	D	4
	30	D	D	D	D	D	D	D
C	Original	-	65	1700	-	535	-	-
	3	3	60	950	44	360	33	2
	7	7	60	1200	29	180	66	4
	15	6	60	D	D	D	D	3
	30	D	D	D	D	D	D	D
D	Original	-	75	3690	-	325	-	-
	3	7	75	3550	4	385	-18	5
	7	*10	*50	D	D	D	D	*6
	15	D	D	D	D	D	D	D
	30	D	D	D	D	D	D	D
E	Original	-	80	4900	-	750	-	-
	3	4	72	***	***	***	***	3
	7	D	D	1395	71	500	33	D
	15	D	D	D	D	D	D	D
	30	D	D	D	D	D	D	D
F	Original	-	60	2250	-	800	-	-
	3	6	60	No samples available for this test.				4
	7	11	50	D	D	D	D	8
	15	11	50	D	D	D	D	7
	30	D	D	D	D	D	D	D

NOTES: D = Deteriorated. *One sample deteriorated. ***Broke during preparation.

BY R. Maddy
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BELL HELICOPTER COMPANY

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TABLE X

SYN-TECH 3913-G GREASE @ 175°F

Material	Days	Volume Change %	Hardness Rex A	(PSI) Tensile Strength	Tensile % Change	Elongation %	Elongation Deviation %	Weight Change %
A	Original	-	70	3360	-	275	-	-
	3	3	70	2860	15	410	-49	3
	7	5	70	3710	11	350	-27	4
	15	7	57	3030	10	300	- 9	3
	30	7	60	930	72	200	27	3
B	Original	-	75	3810	-	375	-	-
	3	4	70	2200	42	440	-17	2
	7	6	70	3280	14	200	47	3
	15	7	55	3250	15	340	9	4
	30	8	52	800	79	250	33	4
C	Original	-	65	1700	-	535	-	-
	3	2	65	1700	0	500	7	1
	7	3	60	1600	6	700	-31	1
	15	6	55	1530	10	675	-26	3
	30	6	60	1310	23	170	68	3
D	Original	-	75	3690	-	325	-	-
	3	4	75	2500	32	250	23	3
	7	7	72	2905	21	310	5	5
	15	9	60	3500	5	320	1	6
	30	9	60	3750	- 2	340	- 5	6
E	Original	-	80	4900	-	750	-	-
	3	2	72	1400	71	650	13	2
	7	4	70	2450	50	800	- 7	3
	15	D	D	2400	51	800	- 7	D
	30	D	D	670	86	200	73	D
F	Original	-	60	2250	-	800	-	-
	3	3	60	No samples available for this test.				2
	7	7	55	**2470	-10	800	0	4
	15	9	50	2500	-11	850	- 6	6
	30	10	50	1810	20	650	19	6

NOTES: D = Deteriorated. **Did not break - ran out of travel (20").

7472 95426

BY R. Maddy
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TABLE XI

MIL-L-7808 OIL @ 250°F

Material	Days	Volume Change %	Hardness Rex A	(PSI) Tensile Strength	Tensile % Change	Elongation %	Elongation Deviation %	Weight Change %
A	Original	-	70	3360	-	275	-	-
	3	14	62	2000	40	375	-36	7
	7	13	60	1660	51	230	16	7
	15	10	60	1110	67	190	31	5
	30	6	60	540	84	100	64	2
* B	Original	-	75	3810	-	375	-	-
	3	13	60	1740	54	390	- 7	7
	7	13	60	1690	56	270	28	7
	15	11	55	1270	67	250	33	6
	30	6	65	570	85	50	87	3
C	Original	-	65	1700	-	535	-	-
	3	22	62	1180	31	350	35	12
	7	24	55	Fabric tore - unable to complete test.				13
	15	24	50	860	49	200	63	13
	30	25	50	470	72	100	81	14
D	Original	-	75	3690	-	325	-	-
	3	19	65	1710	53	300	8	14
	7	19	60	2250	39	275	15	14
	15	16	60	1150	69	220	32	11
	30	8	65	710	81	150	54	5
E	Original	-	80	4900	-	750	-	-
	3	7	70	2000	59	1000	-33	5
	7	8	65	1260	74	750	0	5
	15	8	65	950	81	340	55	6
	30	7	65	360	93	200	73	5
F	Original	MATERIAL NOT SUBJECTED TO MIL-L-7808 OIL DUE TO LIMITED QUANTITY OF SPECIMENS.						
	3							
	7							
	15							
	30							

NOTES: *One sample tested.

7672 55426

TABLE XII

MIL-L-7808 OIL @ 225°F

Material	Days	Volume Change %	Hardness Rex A	(PSI) Tensile Strength	Tensile % Change	Elongation %	Elongation Deviation %	Weight Change %
A	Original	-	70	3360	-	375	-	-
	3	12	65	2250	33	270	2	6
	7	12	60	2210	34	300	- 9	7
	15	12	60	2420	58	300	- 9	6
	30	11	60	1370	59	220	20	6
B	Original	-	75	3810	-	375	-	-
	3	12	67	2650	31	255	32	6
	7	12	62	3530	7	430	-15	7
	15	12	60	3385	11	380	- 1	6
	30	12	65	1250	67	300	20	7
C	Original	-	65	1700	-	535	-	-
	3	15	65	1200	29	230	57	9
	7	15	57	1140	33	490	8	10
	15	16	55	1060	38	500	7	10
	30	17	55	940	45	400	25	11
D	Original	-	75	3690	-	325	-	-
	3	18	70	3105	16	250	23	12
	7	19	65	3320	10	360	-11	13
	15	19	60	2955	20	310	5	13
	30	18	60	1820	51	300	8	13
E	Original	-	80	4900	-	750	-	-
	3	5	75	**3470	29	850	-13	4
	7	4	75	2660	46	700	7	4
	15	5	75	2140	56	900	-20	4
	30	7	70	1020	79	700	7	6
F	Original	MATERIAL NOT SUBJECTED TO MIL-L-7808 DUE TO LIMITED QUANTITY OF SPECIMENS.						
	3							
	7							
	15							
	30							

NOTES: **Did not break - ran out of travel (20").

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BELL HELICOPTER COMPANY

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TABLE XIII

MIL-L-7808 OIL @ 200°F

Material	Days	Volume Change %	Hardness Rex A	(PSI) Tensile Strength	Tensile % Change	Elongation %	Elongation Deviation %	Weight Change %
A	Original	-	70	3360	-	275	-	-
	3	11	65	1440	57	300	- 9	6
	7	10	62	1000	70	240	13	5
	15	11	55	D	D	D	D	5
	30	12	60	D	D	D	D	6
B	Original	-	75	3810	-	375	-	-
	3	12	72	750	80	175	53	7
	7	12	65	1125	70	230	39	6
	15	12	55	D	D	D	D	6
	30	13	60	D	D	D	D	7
C	Original	-	65	1700	-	535	-	-
	3	19	60	1060	38	360	33	10
	7	14	55	870	49	380	29	8
	15	14	55	D	D	D	D	8
	30	22	50	D	D	D	D	12
D	Original	-	75	3690	-	325	-	-
	3	21	62	1455	61	290	11	15
	7	19	60	1100	70	210	35	14
	15	19	60	D	D	D	D	13
	30	21	60	D	D	D	D	15
E	Original	-	80	4900	-	750	-	-
	3	6	75	**2170	56	900	-20	5
	7	5	75	430	91	250	67	4
	15	5	75	D	D	D	D	4
	30	8	65	D	D	D	D	6
F	Original	MATERIAL NOT SUBJECTED TO MIL-L-7808 DUE TO LIMITED QUANTITY OF SPECIMENS.						
	3							
	7							
	15							
	30							

NOTES: D = Deteriorated. **Did not break - ran out of travel (20").

TABLE XIV

MIL-L-7808 OIL @ 175°F

Material	Days	Volume Change %	Hardness Rex A	(PSI) Tensile Strength	Tensile % Change	Elongation %	Elongation Deviation %	Weight Change %
A	Original	-	70	3360	-	275	-	-
	3	7	70	2500	25	365	-33	4
	7	8	67	2290	32	400	-45	5
	15	10	65	4375	-30	400	-45	5
	30	12	60	2930	13	260	5	6
B	Original	-	75	3810	-	375	-	-
	3	7	65	2430	36	335	11	4
	7	9	65	3150	17	410	- 9	4
	15	9	65	2125	44	310	17	5
	30	12	62	3360	12	340	9	6
C	Original	-	65	1700	-	535	-	-
	3	17	65	1270	25	650	-21	11
	7	18	57	D	D	D	D	11
	15	18	55	1060	38	300	44	12
	30	24	55	1030	40	550	- 3	15
D	Original	-	75	3690	-	325	-	-
	3	11	75	1150	69	200	38	7
	7	13	67	2690	27	320	1	9
	15	14	65	4520	-23	350	- 8	10
	30	17	65	2650	28	260	20	12
E	Original	-	80	4900	-	750	-	-
	3	4	75	**3570	27	650	13	3
	7	3	75	**4520	8	750	0	3
	15	3	75	**4090	17	700	7	3
	30	5	70	**3190	35	850	-13	4
F	Original	MATERIAL NOT SUBJECTED TO MIL-L-7808 OIL DUE TO LIMITED QUANTITY OF SPECIMENS.						
	3							
	7							
	15							
	30							

NOTES: **Did not break - ran out of travel (20").

7472 55420

BY R. Maddy
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TABLE XV

MIL-L-23699 OIL @ 250°F

Material	Days	Volume Change %	Hardness Rex A	(PSI) Tensile Strength	Tensile % Change	Elongation %	Elongation Deviation %	Weight Change %
A	Original	-	70	3360	-	275	-	-
	3	16	60	1290	61	225	18	10
	7	16	60	1320	61	255	7	10
	15	13	55	1250	63	280	- 2	8
	30	11	60	820	76	175	36	6
* B	Original	-	75	3810	-	375	-	-
	3	14	60	1570	59	230	39	8
	7	14	60	2100	45	280	25	8
	15	11	60	1650	57	300	20	6
	30	8	60	1310	66	220	41	4
C	Original	-	65	1700	-	535	-	-
	3	17	60	630	63	600	-12	12
	7	19	55	870	49	160	70	14
	15	20	55	600	65	150	72	15
	30	22	50	1330	21	50	91	15
D	Original	-	75	3690	-	325	-	-
	3	22	60	860	77	240	26	17
	7	20	55	980	73	250	23	16
	15	16	55	1030	72	215	34	12
	30	12	55	1110	70	200	38	8
E	Original	-	80	4900	-	750	-	-
	3	9	70	1810	63	800	- 7	6
	7	9	70	**1790	64	1050	-40	7
	15	9	65	1430	71	900	-20	7
	30	9	65	910	81	500	33	7
F	Original	MATERIAL NOT SUBJECTED TO MIL-L-23699 OIL DUE TO LIMITED QUANTITY OF SPECIMENS.						
	3							
	7							
	15							
	30							

NOTES: *One sample tested. **Did not break - ran out of travel (20").

7672 55426

BY R. Maddy
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BELL HELICOPTER COMPANY

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7072 05426

TABLE XVI

MIL-L-23699 OIL @ 225°F

Material	Days	Volume Change %	Hardness Rex A	(PSI) Tensile Strength	Tensile % Change	Elongation %	Elongation Deviation %	Weight Change %
A	Original	-	70	3360	-	275	-	-
	3	12	65	2000	40	280	- 2	7
	7	14	60	2540	24	350	-27	8
	15	15	57	2690	20	370	-34	9
	30	15	60	730	78	125	55	8
B	Original	-	75	3810	-	375	-	-
	3	11	70	1180	69	175	53	6
	7	12	65	3470	9	415	-11	7
	15	13	65	2450	36	350	7	7
	30	13	60	2280	40	275	27	7
C	Original	-	65	1700	-	535	-	-
	3	17	65	1250	26	550	- 3	10
	7	18	57	970	43	220	59	10
	15	20	55	1000	41	430	20	11
	30	21	55	440	74	100	81	12
D	Original	-	75	3690	-	325	-	-
	3	17	70	1840	50	250	23	13
	7	20	65	1545	58	265	18	16
	15	19	62	2050	44	200	38	15
	30	18	60	2730	26	350	- 8	13
E	Original	-	80	4900	-	750	-	-
	3	7	75	**2800	43	800	- 7	5
	7	7	75	**2730	44	850	-13	5
	15	8	75	2430	50	900	-20	5
	30	8	70	1900	61	900	-20	5
F	Original	MATERIAL NOT SUBJECTED TO MIL-L-23699 OIL DUE TO LIMITED QUANTITY OF SPECIMENS.						
	3							
	7							
	15							
	30							

NOTES: **Did not break - ran out of travel (20")

7872 55420

TABLE XVII

MIL-L-23699 OIL @ 200°F

Material	Days	Volume Change %	Hardness Rex A	(PSI) Tensile Strength	Tensile % Change	Elongation %	Elongation Deviation %	Weight Change %
A	Original	-	70	3360	-	275	-	-
	3	11	70	3385	- 1	375	-36	5
	7	14	65	1860	45	280	- 2	7
	15	14	65	1290	61	260	5	6
	30	16	55	930	72	175	36	7
B	Original	-	75	3810	-	375	-	-
	3	8	72	1900	50	240	36	5
	7	12	70	2810	26	340	9	7
	15	11	65	1235	68	275	27	6
	30	15	60	1110	71	200	47	8
C	Original	-	65	1700	-	535	-	-
	3	12	60	1050	38	540	- 1	7
	7	15	55	1400	17	700	-31	9
	15	13	55	860	49	350	35	8
	30	22	50	830	51	250	53	12
D	Original	-	75	3690	-	325	-	-
	3	13	72	4530	-23	350	- 8	9
	7	19	65	2620	29	350	- 8	14
	15	18	65	1480	60	285	12	13
	30	22	55	450	88	200	38	16
E	Original	-	80	4900	-	750	-	-
	3	5	80	4455	9	800	- 7	4
	7	6	75	2090	57	800	- 7	5
	15	5	75	760	84	500	33	4
	30	10	65	670	86	410	45	7
F	Original	MATERIAL NOT SUBJECTED TO MIL-L-23699 OIL DUE TO LIMITED QUANTITY OF SPECIMENS.						
	3							
	7							
	15							
	30							

NOTES:

TABLE XVIII

MIL-L-23699 OIL @ 175°F

Material	Days	Volume Change %	Hardness Rex A	(PSI) Tensile Strength	Tensile % Change	Elongation %	Elongation Deviation %	Weight Change %
A	Original	-	70	3360	-	275	-	-
	3	5	70	2830	16	390	-42	3
	7	7	70	3320	1	350	-27	4
	15	8	65	4080	21	370	-34	5
	30	9	70	3330	1	340	-24	6
B	Original	-	75	3810	-	375	-	-
	3	5	70	4170	- 9	435	-16	3
	7	8	67	3570	6	375	0	4
	15	8	65	3000	21	380	- 1	5
	30	10	70	2590	32	340	9	6
C	Original	-	65	1700	-	535	-	-
	3	11	65	1020	40	600	-12	5
	7	14	60	1350	20	700	-31	6
	15	14	60	1500	12	775	-45	6
	30	16	60	1250	26	390	27	8
D	Original	-	75	3690	-	325	-	-
	3	6	75	4300	-16	400	-23	4
	7	10	70	5740	56	415	-28	7
	15	12	70	3550	4	320	2	9
	30	15	70	4760	-29	410	-26	11
E	Original	-	80	4900	-	750	-	-
	3	3	80	**6710	-37	700	7	2
	7	4	80	4950	-10	700	7	3
	15	3	75	4700	4	775	- 3	3
	30	4	75	**5100	- 4	800	- 7	3
F	Original	MATERIAL NOT SUBJECTED TO MIL-L-23699 OIL DUE TO LIMITED QUANTITY OF SPECIMENS.						
	3							
	7							
	15							
	30							

NOTES: **Did not break - ran out of travel (20").

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BELL HELICOPTER COMPANY

Inter-Office Memo

October 29, 1971
81:RDW:dc-831

Memo to: Mr. C. Sloan

Copies to: Messrs. F. Carlson, M. Gill, C. Harvey, M. Kawa, N. Mackenzie, F. Schroder, ECF

Subject: POST-RUN INSPECTION OF 206A-1/OH58A (SHIP #3) GROUND RUN #3

Reference: (a) IOM 81:RDW:dc-986, September 13, 1971

(b) IOM 81:RDW:dc-667, February 2, 1971

(c) IOM 81:RDW:dc-782, August 31, 1971

Post ground run inspection of the main input drive shaft and tail rotor drive installation on 206A-1/OH58A ship 3 has been completed. Disassembly of the tail rotor drive assembly was accomplished at Plant 6 in the presence of Messrs. McGeehan and Whitford of FAA. A visual inspection of the long drive shaft and hanger bearing assemblies on the 206-040-304-9 (TDEO 206HA-50) was conducted. All rubber collars were properly bonded to the shaft, no bearing spinning had occurred, and all bearings were in satisfactory condition. The 206-040-304-11 fan shaft assembly was also disassembled and visually inspected. All components were satisfactory.

Disassembly and visual inspection of the 206-040-100 (206HA-80-1) main drive shaft assembly and 206-040-400 (206HA51-1) 90° gearbox was accomplished at Plant 5A, again in the presence of Messrs. McGeehan and Whitford of FAA.

The main drive shaft assembly had been assembled with Chicago Rawhide boots, P/N 720405, and titanium drive shaft, 206BA1436-1. All details were in satisfactory condition despite an apparent overheated coupling on one end. Overheating was evidenced by discoloration of male and female couplings and a change in consistency of the coupling grease. The drive shaft assembly was installed for evaluation only, since qualification was not required. No distress was noted.

It is noted that the 206-040-304-9 drive shaft assembly (sub-assembly of -304-7 production install configuration) was modified as follows:

P/N Installed	P/N Replaced
206HA-46-1 Collar (Made from 206-040-350-1)	206-040-315-1 Collar
206HA-47-1 Shield (New additional parts) (Made from 206-040-349-1)	
206HA-9-1 Bearing	206-040-339-5 Bearing
206HA-5-1 Hanger 206-040-351-1 Spacer 206-040-352-1 Spring	206-040-344-5 Hanger Assembly

Also, the 206-040-304-11 fan shaft assembly (sub-assembly of -304-7 production install configuration) was modified as follows:

P/N Installed	P/N Replaced
206-061-432-5 Blower	
206EA-2703-1 Shaft	206-040-320-9 Shaft
206HA-8-3 Spacer 206HA-7-1 Hanger 206-040-352-1 Spring	206-040-346-9 Hanger Assembly
206HA-9-1 Bearing	206-040-339-5 Bearing
206HA-8-5 Spacer 206HA-6-1 Hanger 206-040-352-1 Spring	206-040-345-9 Hanger Assembly
206HA-9-1 Bearing	206-040-339-5 Bearing

Although the 206HA-46-1 collars and 206HA-47-1 shields performed satisfactorily and are considered qualified, no military production of those parts is anticipated. Only the 206-040-339-5 bearings and 206-040-344-5, 206-040-345-9, and 206-040-346-9 hanger assemblies are proposed for military production. The 206-061-432-1 blower and 206EA-2703-1 shaft were installed for evaluation.

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Disassembly of the 90° gearbox revealed pitting in the spiral bevel gear teeth, and the 206-040-408 duplex bearing was rough. Magnetic particles had collected on the chip detector but not in sufficient quantity to activate the chip detector light. This was the third 100-hour tiedown run for this gearbox, and the only part that was installed for qualification was the 206-040-409 roller bearing (MRC 206-224-11). The input and output shaft seals, 525900 and 525894, made by Chicago Rawhide, and the output cap, 206HA-22-1, were installed for evaluation. These parts, including the -409 roller bearing, were in satisfactory condition and suitable for further operation. An oil analysis was made by Wearcheck Inc., and it was determined that chrome and iron levels in the oil were noticeably high, but otherwise o.k. This was consistent with the condition of the bevel gears and the -408 bearing.

A dimensional inspection of the details listed in reference (a) has been accomplished and all parts were found to be within wear replacement limits.

Based on the satisfactory visual conditions and dimensional inspection of the components of the tail rotor drive installation after ground run #3, the following recommendations are made:

1. Incorporate MRC as qualified source for 206-040-409-1 roller bearing.

2. Replace present 206-040-304-1 drive shaft installation with the 206-040-304-7 tail rotor drive shaft installation (per TDEO 206HA-50).

R. D. Walker

R. D. Walker
Transmission Design Group

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